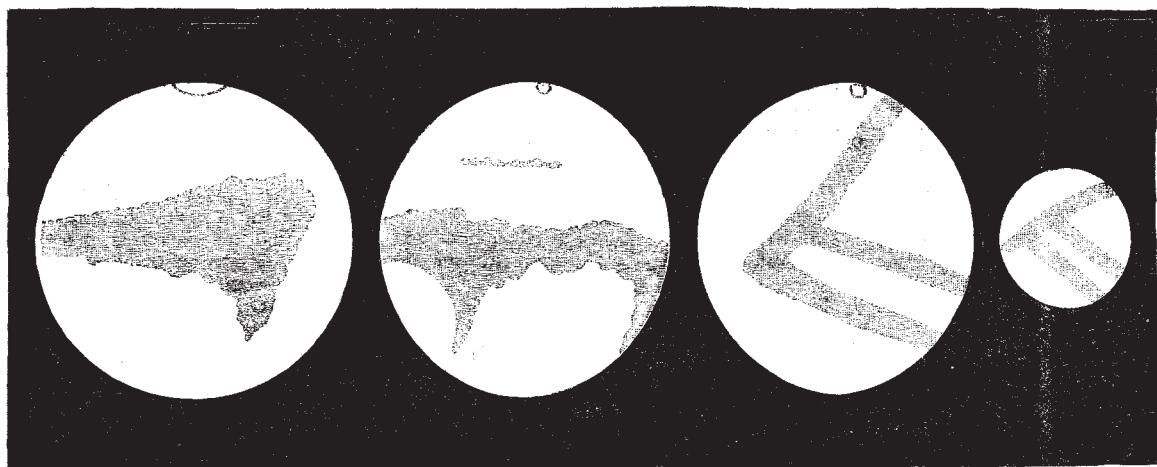


collateral testimony to subsequent observations pointing in the same direction. To say nothing of other authorities, the accurate designs of the deeply-regretted Burton, and the latest delineations of Schiaparelli (independent of the wonderful duplication of the narrow streaks) concur with the drawings of Schröter in indicating one of two suppositions as regards the dark patches of Mars; either they must be liable to long-persistent and very deceptive alteration of visible outline from atmospheric causes, or their own extent must be so variable as to awaken a doubt whether the right key of the mystery is after all in our hands. We have long believed that we hold it, and terrestrial analogy has been thought sufficient to account for all we can see. The result of the next opposition in 1884 may be found to confirm the old hypothesis; but it is not beyond possibility that it may shake it, even past recovery.

Besides the conclusion thus briefly indicated, several other points of varying degrees of interest are touched upon in this comparatively bulky treatise, some of which we may refer to, though only with a passing notice. Schröter paid considerable attention to the polar whiteness; but while he admits the probable analogy of terrestrial snow, he is less confident than some other ob-

servers as to any marked influence of solar radiation. Terby, however, has pointed out the cause of his misapprehension, and his substantial agreement with his compeers. He was aware of the irregular outline of the snowy regions, and thought them slightly different in colour, the south pole verging towards yellow, the north blue. On the question of rotation he could obtain no satisfactory result, as might have been expected from his idea as to the instability of the markings; his values being discordant at different periods: the mean, 24h. 39m. 50²s., was only about 29s. less than that of Sir W. Herschel, but very wide of Proctor's elaborately deduced value, 24h. 37m. 22⁷35s.—a fact pointing probably to the same conclusion as before, that from some as yet imperfectly explained cause, the exact position in longitude of some of the features of the planet is not fully ascertained. The amount of the polar flattening of Mars is, as is well known, matter of much uncertainty. Herschel made it as much 1·16; Dawes, nothing, or even negative. Our observer, nearest to the great English authority, found it less than 1·81, a quantity fairly evanescent. The method of measurement which he adopted throughout all his researches was that of the apparatus which he calls the "projection machine." In this simple



contrivance both eyes are employed simultaneously, the one in viewing the telescopic image, the other in bringing to coincidence with it, a squared-out area in the case of the moon, a series of discs for the planets, in either instance with provision for varying distance and illumination. This binocular mode of measurement, if open to some sources of error not incidental to the ordinary apparatus, appears hardly deserving of the censure so freely bestowed upon it by Beer and Mädler, who were not always fair towards the labours of Schröter; and notwithstanding the perfection to which the wire micrometer has been brought, might perhaps be revived for some purposes with advantage. The diameter of Mars obtained in this way by Schröter, 9° 84', does not differ much from the 9° 8'' (a curious instance, by the way, of notation by thirds), of Sir W. Herschel, or from more modern values—some proof, it may be thought, of the competency of the apparatus to obtain a close approximation.

Observations included in this volume of a partial flattening of the limb of Mars and of the abnormal breadth and want of symmetry in the phasis, however improbable they may at first appear, are not without parallel in the case of other planets, or the experience of other observers. If, as it must be assumed, these are nothing more than illusions, the record of them is still

valuable in the probable event of their occasional recurrence.

To this brief and imperfect notice are appended three sketches from the *Atlas*—the two first as specimens of Schröter's mode of delineation—the third as bearing so striking a resemblance to one of my own, shown on a smaller scale beside it, that it might, in the absence of more accurate data, serve as the basis of an approximate value of rotation.

The dates respectively corresponding to these designs are 1798, Sept. 9d. 8h. 4m.; Oct. 17d. 7h. 39m.; Nov. 13d. 7h. 10m.; 1862, Dec. 10d. 9h. 30m.

T. W. WEBB

DESTRUCTION OF LIFE IN INDIA BY POISONOUS SNAKES

IN January, 1870, being then in Calcutta, I collected statistical information which afforded proof that the loss of human as well as animal life in India from the bite of venomous snakes was very great; and as it seemed to me that this ought to be, to a great extent, preventible, I extended my investigations with the view of obtaining accurate information as to the characters and peculiarities of the venomous snakes themselves, the localities in which they most abound; the *modus operandi*

of the poison ; the circumstances under which the bites are inflicted ; the value of any known remedies in the treatment of those bitten, and what measures might possibly be devised for diminishing this serious evil.

After a long and careful investigation of the whole subject, I drew up a detailed report, containing the results of my inquiry, and presented it to the Government of India, with a request that, when published, it should be distributed throughout India, among civil and medical officers, with a view of enabling them to take measures for the protection of human life, and the destruction of the creatures which caused such frightful mortality. I also endeavoured to point out the mode in which the poison destroys life, and to indicate such rational measures as might be of service in the treatment of those bitten.

I am not aware how far the advice I then tendered has been acted on, but I am glad to find, by a recent resolution published in the *Gazette of India*, that some progress is being made, and that the mortality of 1881 has been somewhat less than that of 1880, from this cause, and that this desirable result is due to the measures that have been taken by Government to procure the destruction of the poisonous snakes.

From the returns furnished to me at the instance of Government in 1870, for the year 1869, I made out that the human deaths from snake-bite were as follows in—

Bengal, including Assam and Orissa	...	6645
North-West Provinces	...	1995
Punjab	...	755
Oude	...	1205
Central Provinces	...	606
Central India	...	90
British Burmah	...	120
<hr/>		
Total....	...	11,416

These were the only returns received, and represent not much more than half of the whole area, but the total, large as it is, cannot be regarded as the real mortality in these provinces, as the information from which the records were framed being probably only partial and imperfect, it rather under-rates than exaggerates the mortality. I expressed a belief that if systematic registration were adopted, the number recorded would prove to be larger, whilst, if information were gathered from the whole of Hindostan, it would be found that not less than 20,000 persons are destroyed annually by snakes.

Certain suggestions were made as to measures for identification, destruction of venomous snakes, and for registration of deaths. These would appear, from the terms of the resolution above referred to, to have been partially adopted, with the result of causing some diminution of the evil. I pointed out that the snakes which are so destructive to life are the cobra, the bungarus or krait, the echis, and the daboia or Russell's viper, all of which are most conspicuous snakes, and easily identified. There are others, such as *Bungarus fasciatus*, *Ophiophagus elaps*, which are dangerous, but comparatively rare, and seldom bite men, whilst the *hydropidae* being confined to the sea or estuaries, are, though very poisonous, not so dangerous to man, and the *trimeresuri*, which are both uncommon, and at the same time are not so deadly as to endanger life. All these are depicted in coloured figures taken from life, which renders their identification simple and easy.

I further remarked that, "meanwhile there exists the obvious necessity of endeavouring to prevent the numerous fatal accidents by making generally known the appearance and habits of the poisonous snakes, and by instituting rewards for their destruction. With a plain description and a faithful representation of each species in colours, every district, medical or police officer, would be able at once to distinguish the venomous from the innocent snakes, and thus knowledge enough, at least

for all practical purposes, might be imparted to intelligent native subordinates, to enable them to recognise the poisonous snakes. By offering a larger reward for these only, their numbers would soon diminish, and the people would be made acquainted with the characters that distinguish the venomous from the harmless snakes, and would learn to avoid them. Thus only, I believe, can the evil be remedied, so long, at all events, as the mode of life among the lower and agricultural classes remain what it now is. I would suggest that magistrates, district and police officers, and civil surgeons be authorised to give the following rewards for poisonous snakes :—

							Annas ^x
Cobra	...	...	...	...	...	...	8
<i>Bungarus caeruleus</i>	...	...	...	...	...	...	6
<i>Bungarus fasciatus</i>	...	...	...	...	...	...	4
<i>Ophiophagus</i>	...	...	...	...	...	...	8
Russell's Viper	...	...	...	...	...	...	8
Echis	...	...	...	...	...	...	4
<i>Trimeresurus</i>	...	...	...	...	...	...	2

The sum disbursed would no doubt be large, but the results in the saving of life and destruction of snakes would compensate for the expenditure."

Such was the state of things when I left India in 1872. The Government of India then, at my instance, appointed a commission to continue the inquiry which I had commenced three or four years previously. This resulted in several valuable reports by Drs. J. Ewart, A. Wall, and Mr. Vincent Richards, whilst, in conjunction with Dr. Lauder Brunton, F.R.S., an investigation into the nature of the physiological action of the virus was continued here by me, the results of which have been published in the *Proceedings of the Royal Society* in 1873, 1874, and 1875. Meanwhile the evil continues, and it is probably within the mark to say that, since the subject came under consideration in 1870, 150,000 to 200,000 human beings, to say nothing of domestic animals, have been destroyed by snake bites.

The subject has often received the most anxious consideration of the Indian Government, and a variety of measures have been resorted to, not without a certain measure of success; but it is my belief that not until a system of organised, determined, and sustained efforts for the destruction of the snakes is adopted and carried out on the lines suggested in my report, will the evil be fairly grappled with and overcome. The present resolution shows that the matter is again receiving some consideration, and there is good reason to believe that if the measures be prosecuted with energy and determination throughout India, good results will follow. But I repeat it is only by the *destruction of the snakes* that the evil can be mitigated. Something may be expected from the people themselves as their knowledge of the subject increases, as they become more familiar with the appearance or character of the venomous as distinguished from the harmless snakes, and as they gradually become convinced of the futility of all antidotes charms or spells to protect them; or should they ever alter their present mode of living in huts which have the floor on the ground surface, to huts with raised floors—a consummation devoutly to be wished, not only on account of snakes, but of malaria—but hardly likely to be realised.

For the purpose of hunting out and destroying the evil it is absolutely necessary that a fixed system of rewards should be established, and that in every district there should be an organised body of men whose duty it would be, under proper supervision, to seek out and destroy the snakes, receiving a recompence according to the importance and number of the snakes killed. Such men are to be found among certain castes, and with the aid of descriptions and coloured drawings, such as now are available, there need be no great difficulty in carrying out this much-to-be-desired object. That such a project would be costly is true, but can that cost be considered excessive

^x Eight annas represent one shilling.

if it save thousands of lives of men and valuable animals? There can be little doubt that wherever such a system has been even partially carried out, it has been effective; it needs but combined effort to make universal, that which hitherto would appear to have been but partial success.

From the tenor of the Government resolution referred to, it seems as though an organised scheme for the destruction of venomous snakes, as well as dangerous wild animals, is now likely to be generally adopted in India, and should it be so, there is good ground for hope that the great mortality will decrease—to quote from a former paper on this subject, I would repeat: "Rewards should be offered freely for venomous snakes only. This, if steadily carried out under some responsible official, would soon diminish snakes and deaths from snake-bite; and I earnestly protest against the opinion expressed by some Indian authorities, that such rewards are useless—useless they may have been, and will continue to be, if distributed without discretion for snakes not poisonous. If this method of dealing with the matter—and who can deny its importance—be adopted (but it must be done willingly, and not with the foregone conclusion that it will fail), I am certain that, as part of a comprehensive scheme for the destruction of noxious animals generally, it will succeed."

The following is the purport of the resolution of November 8, 1882, which shows that in 1881 the number of deaths caused by snake-bite, of men and animals, contrasted favourably with that of the previous year, 1880.

The statement appended to this resolution shows in detail for each province the number of persons and cattle killed by wild animals and snakes, and the number of wild animals and snakes destroyed, with the rewards paid for their destruction during the year 1881, as compared with the previous year. The figures are summarised in the following tables:—

Number of Human Beings and Cattle Killed by Snakes

	Persons killed.		Cattle killed.	
	1880.	1881.	1880.	1881.
Madras	1,182	1,064	227	273
Bombay	972	1,024	89	191
Bengal	10,064	9,208	1,248	154
North-Western Provinces and Oudh ...	4,723	5,010	221	317
Punjab	681	744	78	69
Central Provinces ...	901	985	39	26
British Burma ...	149	135	194	150
Coorg	3	Nil	Nil	Nil
Assam	211	189	57	16
Hyderabad Assigned Districts ...	125	197	383	836
Ajmere-Merwara ...	49	54	Nil	Nil
Total	19,060	18,610	2,536	2,032

Snakes killed and Rewards Paid

	Destroyed.	Rewards.	Destroyed.	Rewards.
	1880.	Rs. a. p.	1881.	Rs. a. p.
Madras Nil	Nil	Nil	Nil	Nil
Bombay 177,078	6,922	3 6	207,113	6,214 0 0
Bengal 23,201	3,733	3 6	19,282	3,430 5 0
N.W. Provinces and Oudh... 1,029	10	2 0	1,142	56 5 3
Punjab..... 9,126	635	5 0	22,279	1,587 4 0
Cent. Provinces 866	336	6 0	1,493	562 8 0
British Burma. 997	2	0 0	2,990	27 0 0
Coorg..... 58	Nil	...	16	4 0 0
Assam..... 202	Nil	...	300	34 0 0
Hyderabad As-signed districts 158	23	14 0	332	45 8 0
Ajmere-Merwara 61	Nil	...	21	Nil
Total ... 212,776	11,663	2 0	254,968	11,960 14 3

The deaths of human beings from snake-bite were, in 1880, 19,060; while in 1881 they were 18,610.

In 1880, 212,776 snakes were destroyed at a cost of Rs 11,663.

In 1881, 254,968 snakes were destroyed at a cost of Rs 11,961.

Thus with an increased expenditure of Rs 298 in 1881, 42,192 more snakes were destroyed and 450 lives were preserved, above the expenditure of the previous years.

With regard to the measures adopted for the destruction of venomous snakes, the following remarks are made by the Governor-General in Council:—

"As regards the destruction of venomous snakes, special measures were adopted in some provinces, of which it appears desirable to give a brief account in case they may be considered suitable for adoption elsewhere. In Bengal a scheme has been sanctioned by the local Government in the case of the Patna Division, under which persons destroying snakes can obtain certificates from certain selected planters vouching for the poisonous nature of the snakes destroyed. The production of such a certificate entitles the holder to secure from the local authorities the reward offered whenever he finds an opportunity of applying for it. As observed by the Government of Bengal, this concession will probably be found to add much to the convenience of persons claiming rewards, and to act as an inducement towards the destruction of poisonous snakes. The expediency of extending the scheme will be considered by the Local Government when the result of the current year's operations are known. In the North-Western Provinces and Oudh the Lieutenant-Governor and Chief Commissioner has sanctioned the entertainment tentatively in each district of those provinces of a staff of Kanjars, or men of similar caste, who trap and kill reptiles, for the systematic destruction of venomous snakes. These men will receive pay at the rate of Rs. 2 per mensem, together with an additional reward of two annas for every venomous snake in excess of twenty destroyed by each man during any month. A gang of snake-hunters is also to be employed at each tahsili, and, if the measure proves successful, it is proposed that similar gangs should be eventually appointed to each police circle of other local area. It appears to the Governor General in Council that a plan for the destruction of snakes such as that initiated in the North-Western Provinces and Oudh, is likely to prove far more efficacious than the mere offer of rewards, although it is true that unless such operations are confined to towns and villages and their neighbourhood, where it is believed that the largest number of deaths occur from snake-bite, they will probably be very costly. His Honour the Lieutenant-Governor of the Punjab has issued a circular to commissioners and superintendents in the Punjab, drawing attention to the matter with a view to the adoption of measures for destroying snakes by system of rewards to be granted by district committees and municipalities. Casts and lithographed pictures of the more common species of deadly snakes have already been supplied to the police stations in some districts, and deputy commissioners have been requested to suggest to municipal and district committees the desirability of procuring similar means of reference for the purpose of testing applications for rewards. In British Burma the Chief Commissioner, with a view to encourage village snake-hunts in the rice plains, has arranged to grant sums varying from Rs 10 to Rs 20, according to the number of houses, in aid of a feast or *pweh* at the end of the annual hunt to every village which successfully carries out such an undertaking.

"On the whole, the results recorded during the year under review appear to the Government of India to be more satisfactory than those of the previous year. The Governor General in Council is glad to notice that the question of taking measures to reduce the lamentable loss of life which is at present caused by wild animals and venomous snakes is receiving the earnest consideration of Local Governments and Administrations, and His

Excellency in Council will await with interest the reports showing the results of the special measures which have been adopted in some provinces. It is clear that much still remains to be done; but if sustained efforts are made and well-considered plans adopted for the extermination of wild beasts and deadly snakes, His Excellency in Council believes that the number of deaths from these causes will in course of time be materially reduced.—Simla, November 8, 1882."

From the above it appears that more vigorous measures than any hitherto adopted have been taken for the destruction of venomous snakes, and the contrast of the results of 1881 with those of 1880, warrant the anticipation of further benefit if these measures are only carried out with a sustained determination to succeed. It is mainly a question of perseverance and the expenditure of money, and one can hardly imagine a more desirable object on which to expend both energy and rupees. But it is essential that the system be laid down on some general principles for the whole of India, to be worked out in detail, according to the needs or peculiarities of each district. There should, in short, be a department with a responsible chief and subordinate agents, for whom certain rules should be laid down to be carried out steadily and without hindrance throughout the country, leaving much of the detail to the discretion of local authorities. I would insist on the importance of carrying it out on broad principles everywhere. When such a department is constituted under a proper head—and there are many persons well fitted for such a duty—then, I believe, venomous snakes and other noxious animals will decrease in numbers, and people will cease to be startled by these appalling losses of life.

J. FAYRER

SIR J. WHITWORTH'S MECHANICAL PAPERS¹

THE fact that, by an order in Council of August 26, 1881, some 300 Whitworth gauges of various dimensions have been adopted as standards by the Board of Trade, is so important a recognition of the value of the labours of Sir J. Whitworth in improving mechanical measurement, that the occasion has been selected for republishing certain papers which have been long well known among engineers, but which have not hitherto been accessible to the public generally.

The first paper in the series is on plane metallic surfaces, and the proper mode of preparing them, and contains an account of an invention of great simplicity, but of the highest practical importance. Such plates, when worked up to an extreme degree of accuracy and finish, form an approximation to a plane surface which would surprise and delight any geometer who had an opportunity of critically examining and testing their qualities. They consist of an assemblage of minute bright surfaces very evenly distributed over a plate of cast iron, and very near together.

As to their qualities, there is not space here to describe them, but they have formed the subject-matter of an excellent lecture by Prof. Tyndall, at an evening meeting of the Royal Institution in the year 1875.

Passing from these so-called true planes, we refer to a step involving an original conception which has led to the construction of the new standard gauges. The production of an approximately true plane surface gave an increased value and importance to the feeling of contact between prepared metallic surfaces, and resulted in the invention of a measuring machine which was made to depend on the sense of touch instead of upon optical contrivances, and was founded entirely on truth of surface.

¹ "Papers on Mechanical Subjects." By Sir Joseph Whitworth, Bart., F.R.S., D.C.L., Vol. I. True Planes, Screw Threads, and Standard Measures. (London: Spon.)

The improvement consisted in the substitution of end for line measure, and inasmuch as these are technical terms, it may be well to explain them.

As stated in the last paper of the series, the English standard yard is an example of line measure, being represented by the interval between two lines drawn across two gold studs sunk in a bronze bar about 38 inches long, the temperature being at 62° Fahrenheit.

The standard yard, from the subdivisions of which the standard inch has been obtained on the Whitworth system, is a rectangular metal bar with plane sides capable of resting along its whole length in rectangular V grooves, which are plane surfaces, while the ends of the bar are planes lying perpendicular to its axis. The bar is exactly 36 inches long, and the measurement is complete when the degree of contact between its ends and two small true planes abutting against them is ascertained. Such a measurement is, of course, end measure, and its accuracy depends throughout upon truth of surface, and also upon truth of position of surface. The ends of the bar must be perpendicular to its axis, and the planes which feel those ends must be truly parallel to each other, and one at least must be movable to and fro without deviating at all from the position of parallelism to its fixed neighbour,

Then comes the question of the amount of shifting of the movable plane. That is done by a micrometer screw, the linear motion for one graduation of the micrometer head, which can be easily read without a lens, being in some cases 1-10,000th of an inch, and in other cases 1-1,000,000th of an inch.

There is not space to discuss the measuring machine, whether as capable of producing cylindrical gauges varying by 1-10,000th of an inch, or as capable of reproducing a standard inch or a standard yard to a degree of accuracy which leaves the microscope far behind in the contest.

It must suffice to point out that the reprinted papers are full of interest, as showing the manner in which Sir J. Whitworth has thought out and accomplished the work of improving the construction of machinery, and it is matter of regret that those who are occupied in teaching mechanics have not better opportunities than now exist of becoming practically conversant with the subject-matter of the collected papers.

NOTES

FROM Punta Arenas, near the extremity of South America, intelligence has been received that the fourth section of the German expedition sent out to observe the transit of Venus has been particularly successful, Professor Auvers having managed to take exceedingly good photographs and numerous measurements.

A TELEGRAM received from Monte Video states that the *Volage* has anchored in these roads from Santa Cruz in Patagonia. Capt. Fleurais and observers of the transit of Venus were on board, returning to France with their instruments, photographs, and other documents.

M. TRÉPIED, in a communication to the Paris Academy on his observation of the transit in Algiers, states that clouds rendered the ordinary observations of little value, but that some good results were obtained with the spectroscope on the borders of the planet in the region from A to E; while some photographs were obtained in the green, the blue, and the violet. The examination of the spectral lines in the groups A, B, α , in the regions comprised between α , D, E, did not show, M. Trépied states, anything which could be attributed to a selective absorption produced by an atmosphere on the planet. The same inference is deduced from the photographs.